United States Department of Agriculture
Midwest Climate Hub

Developing Useful Decision Tools – the U2U Experience

Cross-Border Workshop
18 October 2017
Syracuse, NY

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Developing tools agenda

- Background on tools and experience
- U2U/Corn CAP survey and background information
- U2U tools process

Tools

- Dictionary.com
- Def 5: anything used as a means of accomplishing a task or purpose:
  - Education is a tool for success.

- Todey modification
  - Something that interprets, combines or modifies data to help make a decision

Before you develop any tool

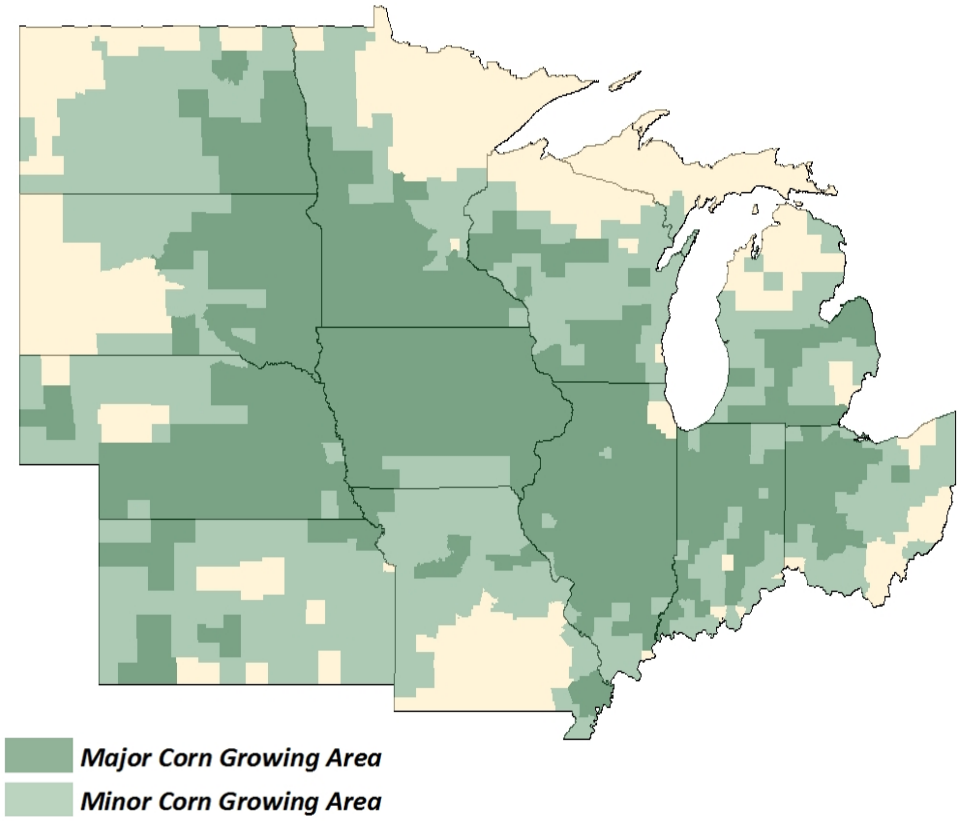
- Who is your user/stakeholder?
- Have you talked to anyone who would use it?
- Do you plan on talking to them?
- Are they going to give you feedback on it?

Considerations on tool development

- Tools are only useful if someone uses them…
  - Are you answering a question for someone who is trying to make a decision?
  - Do people know about the tool?
  - Do they know how to use it?

- Matching research to tools is not a direct process (if you have not addressed these questions before starting research/tool development you likely won't succeed)

About U2U



Our Vision

- Transform existing climate information into usable knowledge for agricultural decision making
- Give farmers the resources and training to more effectively manage variable climate conditions
- Increase Extension capacity to address agro-climate issues

More **resilient** and **profitable** farms in a variable and changing climate

U2U Team

climatologists, crop modelers, agronomists,
IT specialists, economists, sociologists, Extension, and more

PURDUE UNIVERSITY

IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY

MICHIGAN STATE UNIVERSITY

ILLINOIS

SDSU

MICHIGAN

MU

University of Nebraska Lincoln

UW Extension Cooperative Extension

High Plains Regional Climate Center

MRCC Midwestern Regional Climate Center

National Drought Mitigation Center

Thank you!

Follow Us on Twitter!
@AgClimate4U

AgClimate4U.org

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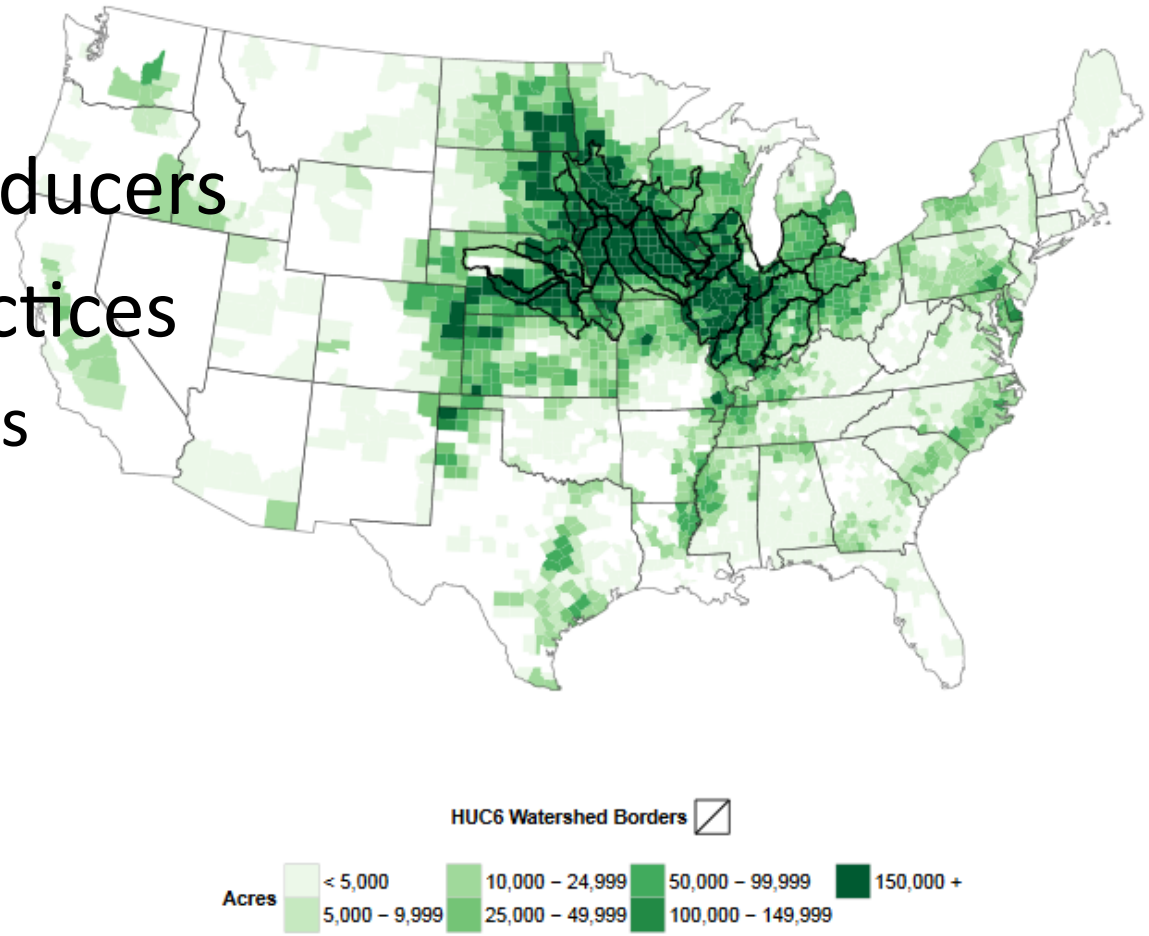
United States Department of Agriculture
National Institute of Food and Agriculture

Purdue University · Michigan · Illinois · Iowa State University · Michigan State University · Missouri · University of Nebraska Lincoln · UW Extension Cooperative Extension · MRCC Midwestern Regional Climate Center · High Plains Regional Climate Center · National Drought Mitigation Center · SDSU

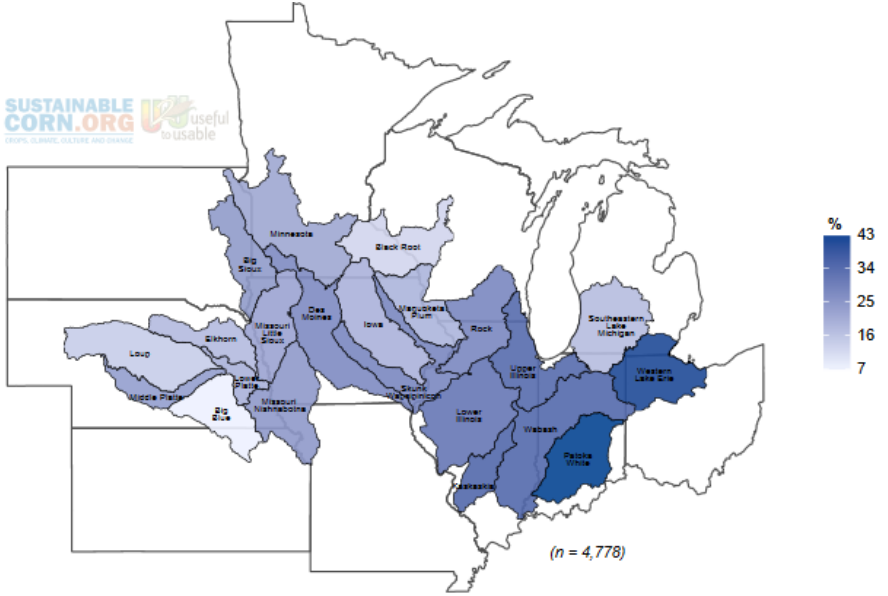
https://sustainablecorn.org/index.html

Farmer Survey

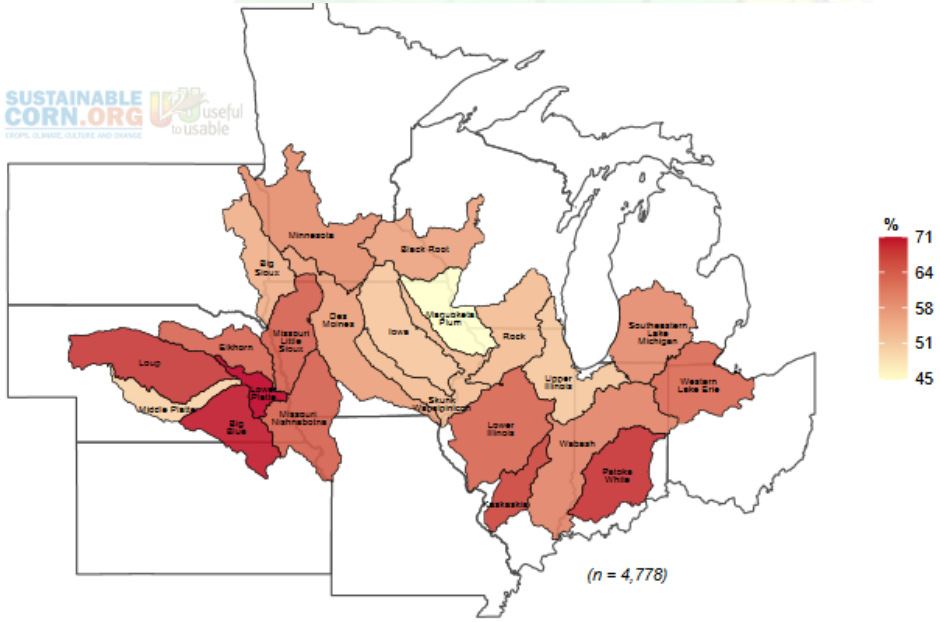
- Spring 2012
- 4778 corn producers
- Attitudes, practices
  - Vulnerabilities
- 1st of its kind



Map 2. Study watersheds overlayed on acres of corn harvested by county in 2007 (USDA 2009a).



Map 21. Increased flooding (Q5A), percent concerned or very concerned.



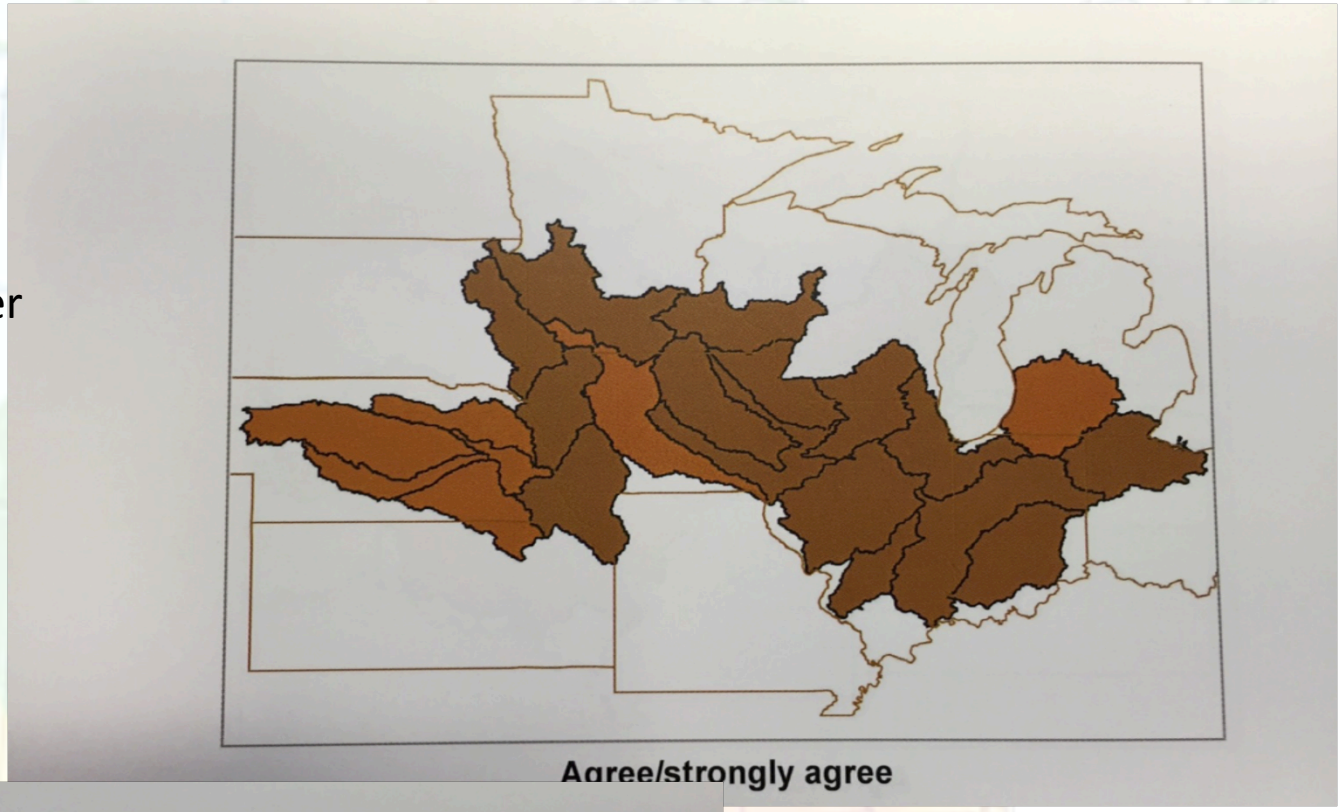
Map 22. Longer dry periods and drought (Q5B), percent concerned or very concerned.

https://sustainablecorn.org/What_Farmers_are_Saying/Farmer_Survey.html

Strongly Agree More Variable/Unusual Weather

Other survey results indicate low 40s% blaming changes on human activities

Survey of 4778 producer 2012



% of farmers, by HUC6 watershed

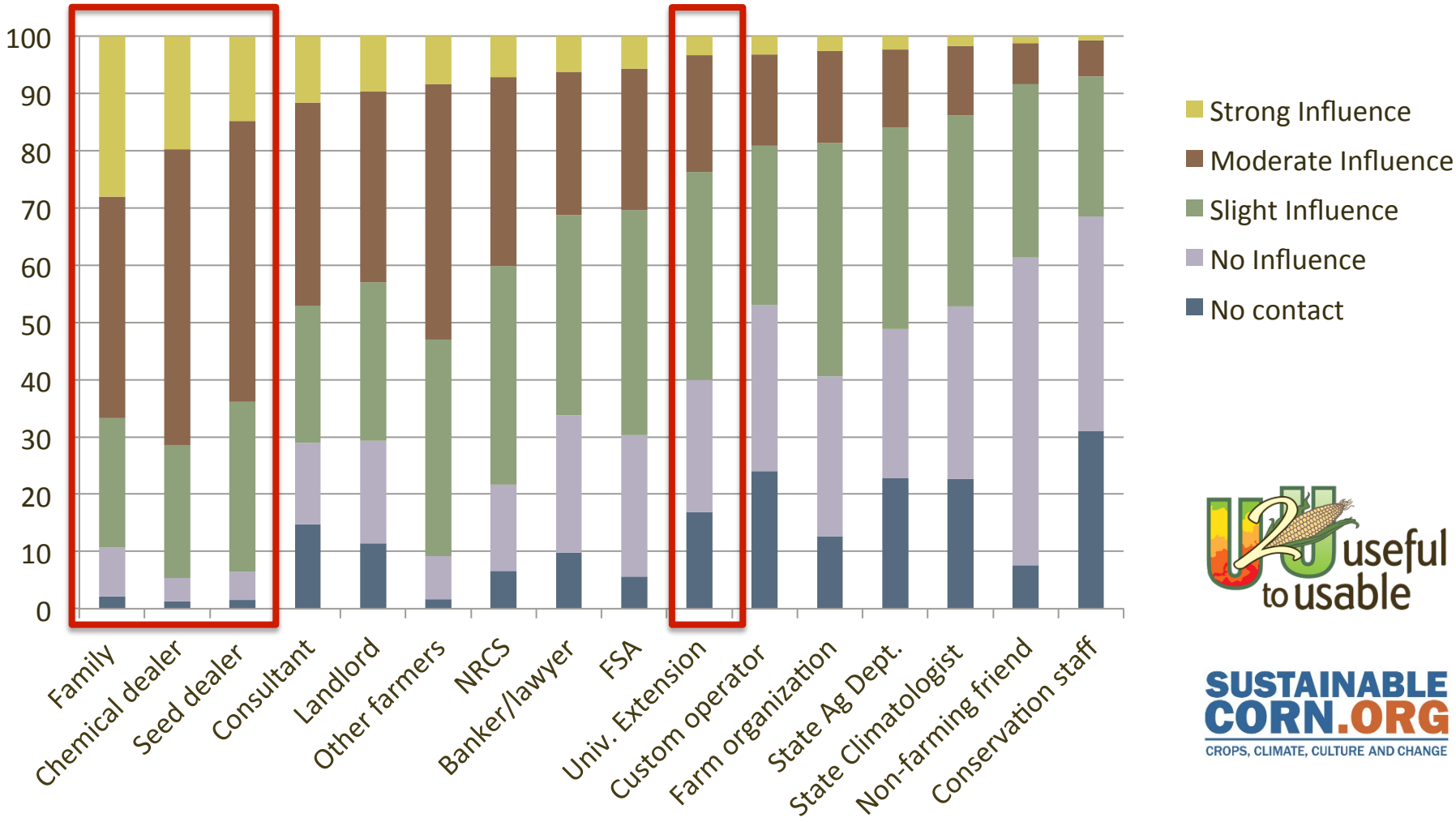
0.0 - 10.0%	40.1 - 60.0%
10.1 - 20.0%	60.1 - 80.0%
20.1 - 40.0%	80.1 - 100.0%

useful to usable

SUSTAINABLE CORN.ORG
CROPS, CLIMATE, CULTURE AND CHANGE

http://www.sustainablecorn.org
http://www.agclimate4u.org

Q: Please indicate how influential the following groups and individuals are when you make decisions about agricultural practices and strategies

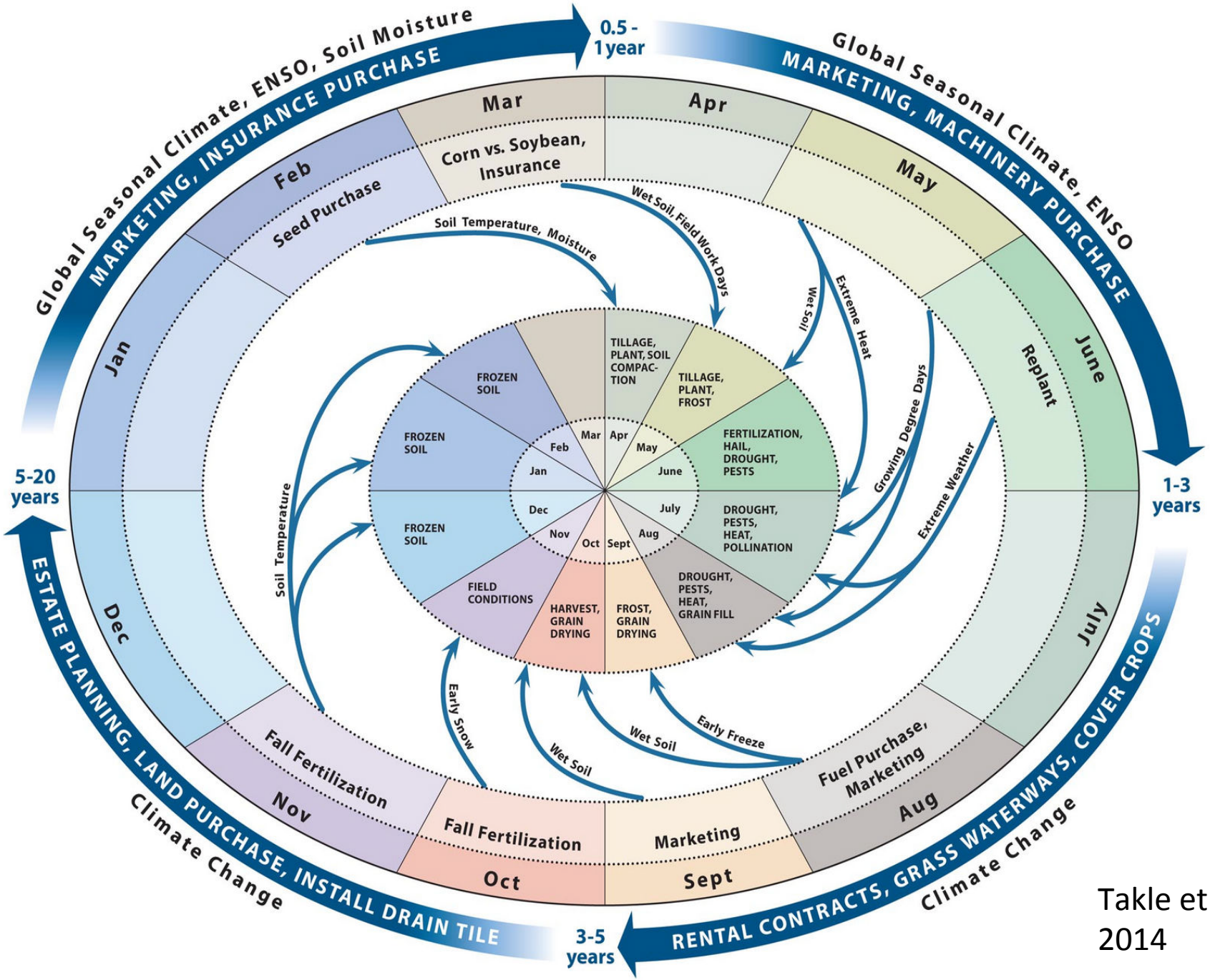


Results from a 2012 survey of Midwestern corn producers conducted by Useful to Usable (U2U) and SustainableCorn.org

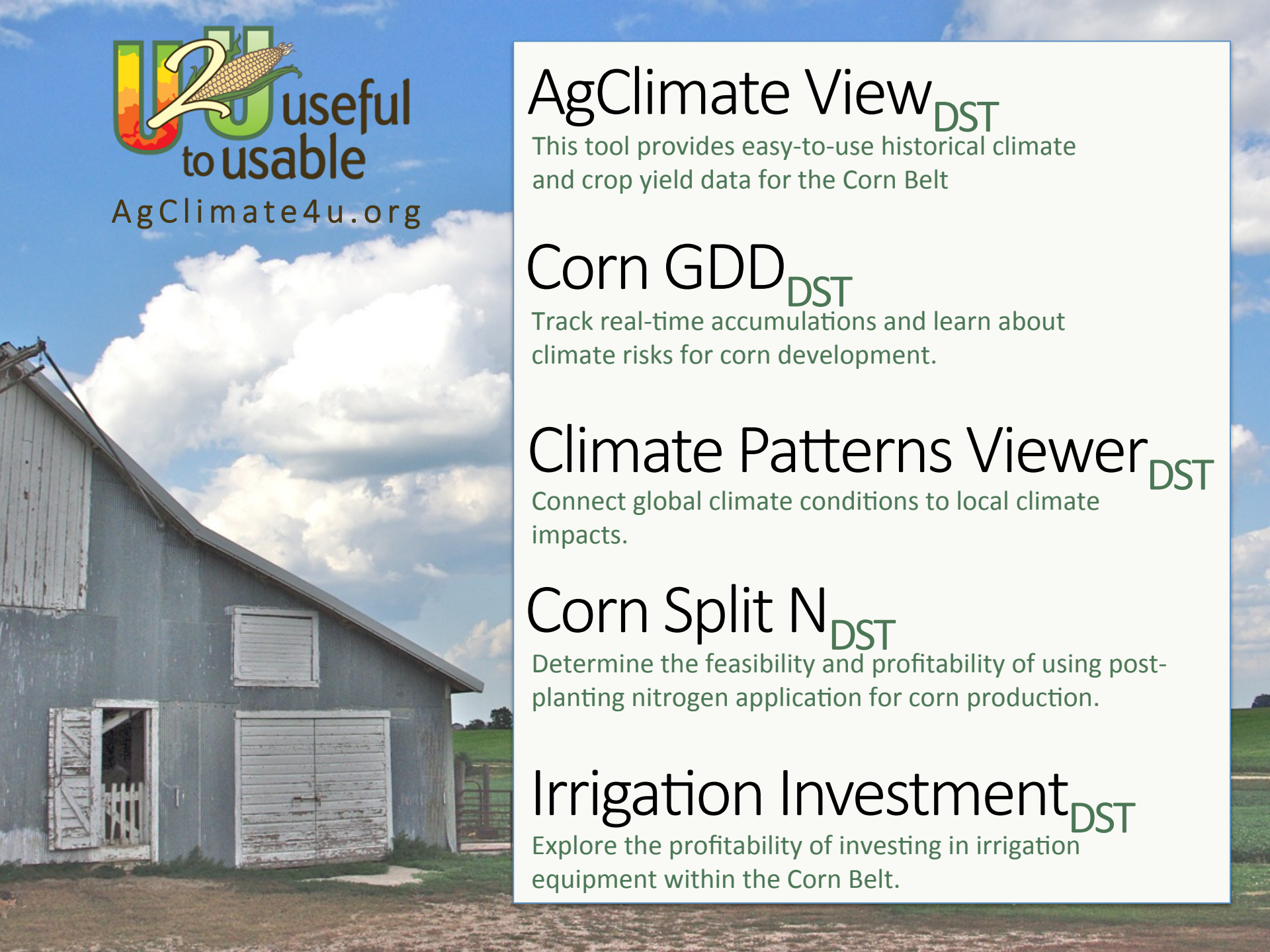
Prokopy et al. 2014. "Adoption of Agricultural Conservation Practices: Insights from Research and Practice" Purdue Extension Publication FNR-488-W.

Decision needs

- Agriculture frequently is looking for forecast/ outlook information.
- Can we provide information with skill when needed?
  - Seed company decisions incentivized in the fall.
  - Can we tell people anything about the next season at that point?



Takle et al. 2014



AgClimate View DST

This tool provides easy-to-use historical climate and crop yield data for the Corn Belt

Corn GDD DST

Track real-time accumulations and learn about climate risks for corn development.

Climate Patterns Viewer DST

Connect global climate conditions to local climate impacts.

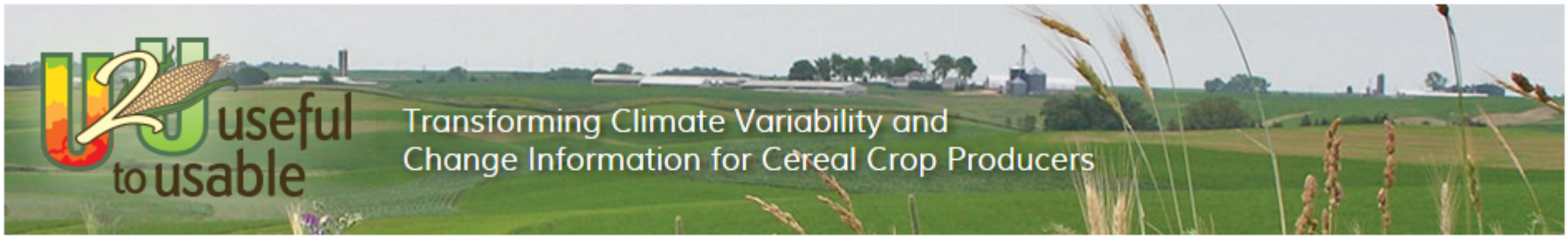
Corn Split N DST

Determine the feasibility and profitability of using post-planting nitrogen application for corn production.

Irrigation Investment DST

Explore the profitability of investing in irrigation equipment within the Corn Belt.

Decision Dashboard



DECISION DASHBOARD | MEDIA CENTER | NEWSLETTER | ABOUT US

Decision Dashboard

U2U$_{DST}$ Suite | Other Decision Resources | Agro-Climate Reports | Weather/Climate Maps | Drought Info | Climate Outlooks | Helpful Links

U2U$_{DST}$ SUITE

AgClimate View$_{DST}$

A convenient way to access customized historical climate and crop yield data for the U.S. Corn Belt. View graphs of monthly temperature and precipitation,

Corn GDD$_{DST}$

Track real-time and historical GDD accumulations, assess spring and fall frost risk, and guide decisions related to planting, harvest, and seed selection.

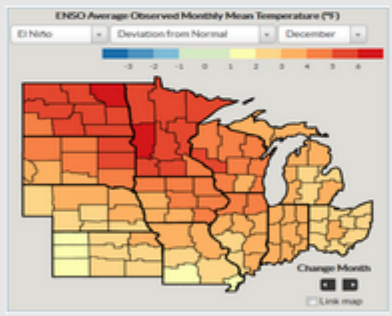
www.AgClimate4U.org

Decision Support Tools

U2U$_{DST}$ SUITE

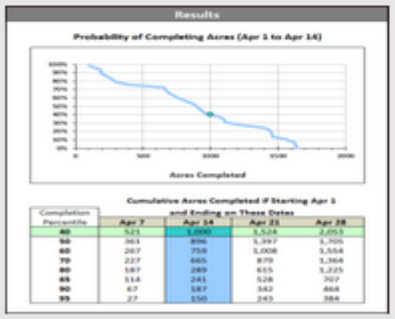
AgClimate View$_{DST}$

A convenient way to access customized historical climate and crop yield data for the U.S. Corn Belt. View graphs of monthly temperature and precipitation, plot corn and soybean yield trends, and compare climate and yields over the past 30 years.



Climate Patterns Viewer$_{DST}$

Discover how global climate patterns like the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) have historically affected local climate conditions and crop yields across the U.S. Corn Belt.

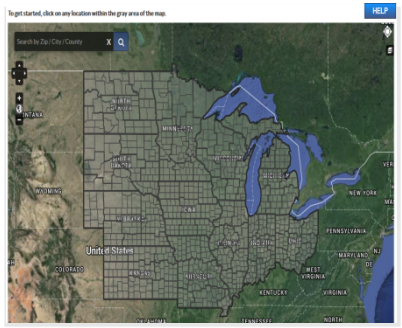


Probable Fieldwork Days$_{DST}$

This spreadsheet-based tool uses USDA data on Days Suitable for Fieldwork to determine the probability of completing in-field activities during a user-specified time period. This product is currently available for Illinois, Iowa, Kansas, and Missouri. (Hosted by the University of Missouri)

Corn GDD$_{DST}$

Track real-time and historical GDD accumulations, assess spring and fall frost risk, and guide decisions related to planting, harvest, and seed selection. This innovative tool integrates corn development stages with weather and climate data for location-specific decision support tailored specifically to agricultural production.



Corn Split N$_{DST}$ (NEW!)

Determine the feasibility and profitability of using post-planting nitrogen application for corn production. This product combines historical data on crop growth and fieldwork conditions with economic considerations to determine best/worst /average scenarios of successfully completing nitrogen applications within a user-specified time period.

www.AgClimate4U.org

Considerations on tool development

- Tools are only useful if someone knows how to use them…
  - Do people know about the tool?
  - Do they know how to use it?
  - Have you incorporated their feedback?

We strive to transform <u>useful</u> information into <u>usable</u> tools that *actually get used*!

Stakeholder interaction, from the beginning and throughout the entire process, is essential!

Regular **evaluation** of our tools, and our team, to ensure we are meeting needs.

Photo credit: https://fromasecondstorywindow.wordpress.com/

Stakeholder Interactions for DST Development

- Surveys
- Focus groups
- Usability testing
- Outreach & hands-on training
- Evaluations

What makes a tool or website useful?

- Usability (ease-of-use)
  - Components include: learnability, efficiency, memorability, errors and satisfaction
- Utility (functionality)
  - Does it meet a users' needs?

Useful = Usability + Utility

Nielsen, J. (2012). Usability 101: Introduction to usability. Retrieved from http://www.nngroup.com/articles/usability-101-introduction-to-usability/

Example Feedback – U2U Irrigation Investment Tool

Results: Returns over System Lifetime –

Net Present Value Discounted after Tax Cash Flow	**$12,035**
Internal Rate of Return Before Tax	**5.82%**
Internal Rate of Return After Tax	**6.00%**

Is it profitable for me to invest in irrigation?
If the "Net Present Value Discounted After Tax Cash Flow" is a positive value, it means an investment in irrigation equipment would be profitable. If this value is negative, installing an irrigation system would not profitable.

Number of Years Having an Irrigation System Would Gain/Lose Money
Based on conditions from 1981-2005

How is this calculated?

Next round

- Testers HATED the stoplight
- Still didn't seem to notice the right side was showing a historical analysis

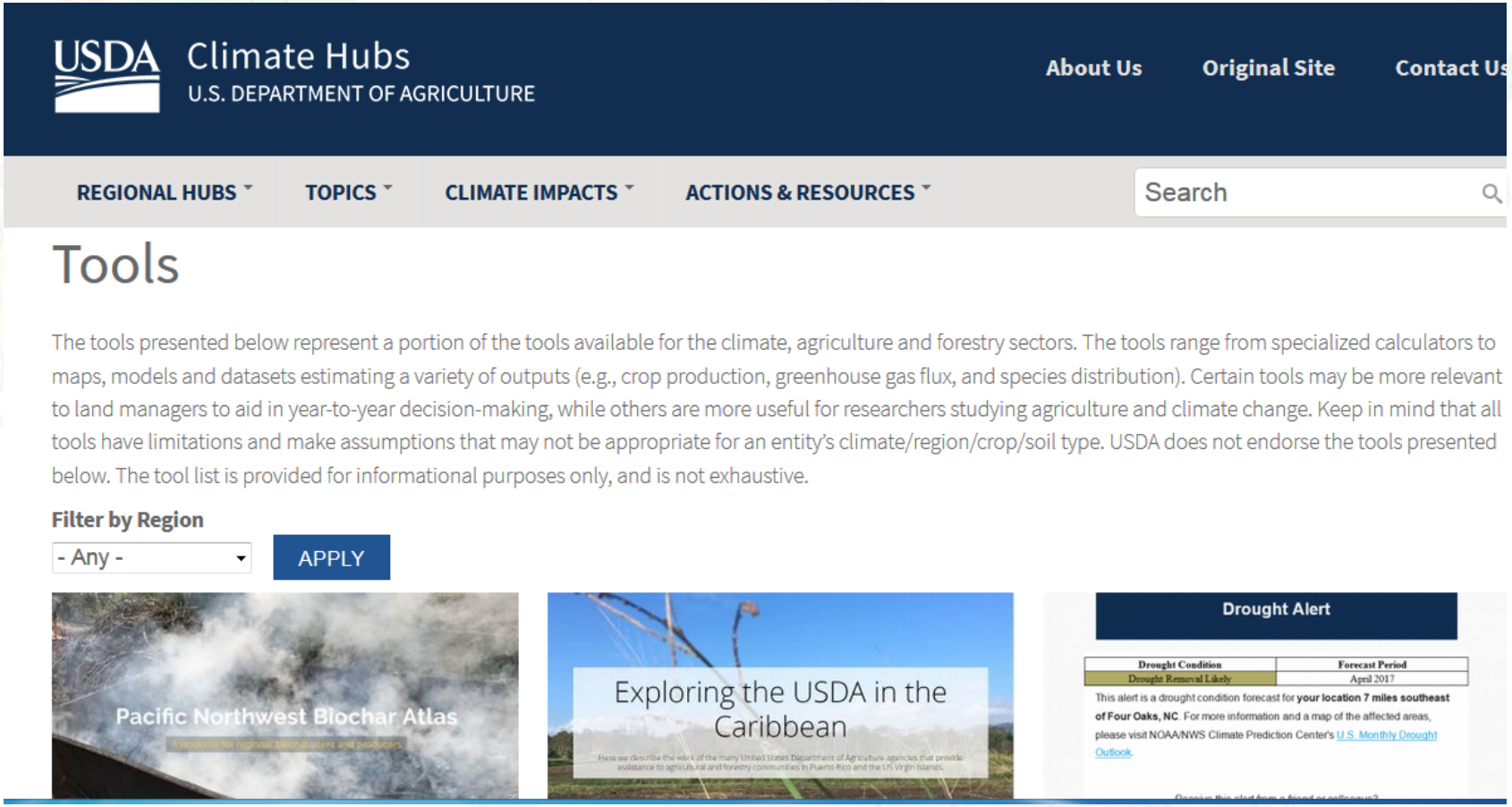
Considerations on tool development

- Trusted source versus attractiveness
  - Tools/apps can look really pretty
  - Give you an answer
  - Are they based on real/correct data?

- Look and feel are important
  - Need to follow common conventions

Considerations on tool development

- Data not available anywhere
  - Mesonet data in certain areas helps
- Data detail may not exist (precision ag)
  - Temporal, spatial, skill, etc.
- Private-public partnerships need to be developed for a number of reasons



USDA United States Department of Agriculture
Midwest Climate Hub

https://www.climatehubs.oce.usda.gov/tools

Considerations on tool development

- Are people willing to make decisions?
- Are they ready to adapt to changes?

- Hint – keep a social scientist close by….

Who are your friends/partners?

- Extension/outreach
- State climatologists
- Producers
- Whomever your user group is….

Improving climate info for ag

Mase and Prokopy (2014). Unrealized Potential: A Review of Perceptions and Use of Weather and Climate Information in Agricultural Decision Making. *Weather, Climate, and Society*, **6**(1): 47-61.

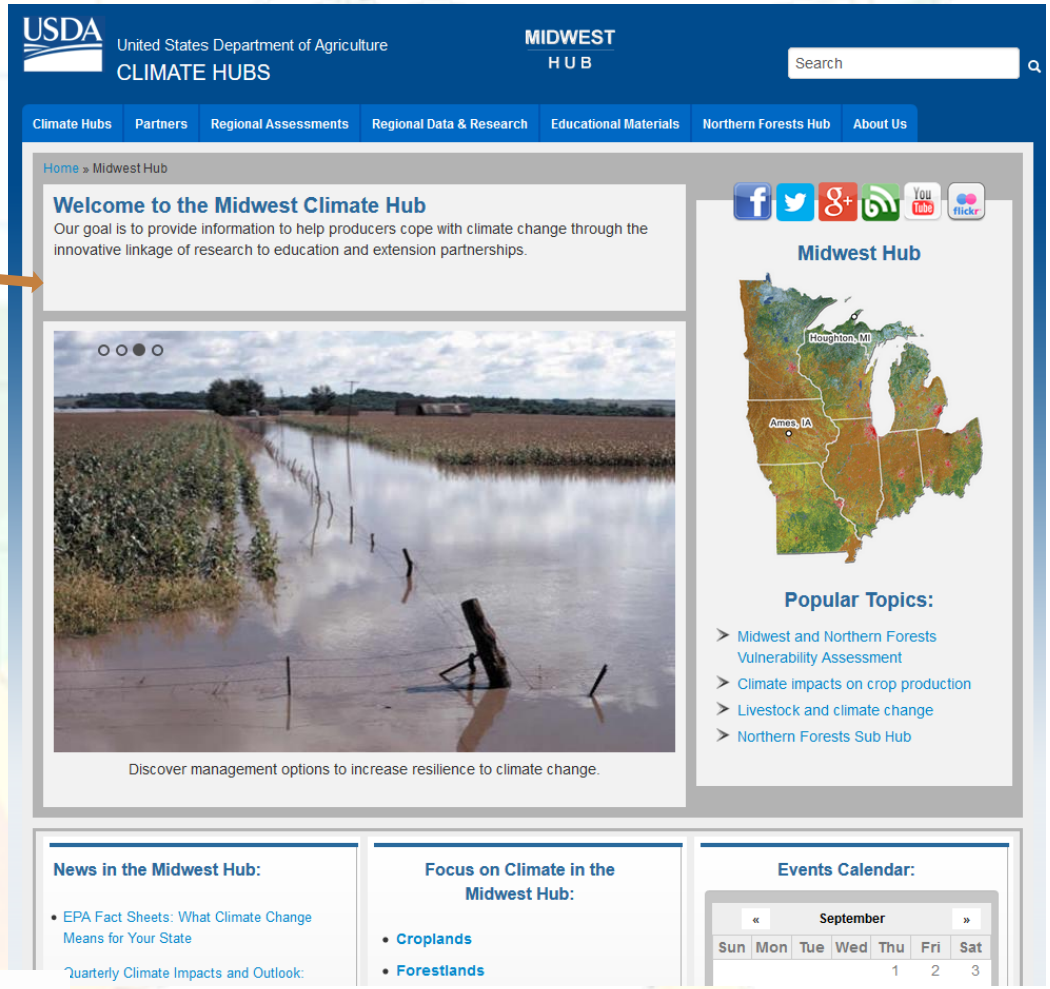
- Weather and climate products must be
  - Useful, relevant, context-specific
- Usability and packaging matters
- Collaborative development with end-users is critical
  - Encourages buy-in, trust, sustained product use
- Further explore the role of ag advisors

Actionable information needed for effective decision making!

Tools

- Effective tools take a concerted planned effort to use current knowledge/information to answer a question some stakeholder group needs to address.
- It is a time consuming intentional process to create useful and usable tools.

Keeping Up-to-Date with the Midwest Climate Hub



Climate Hubs Website
www.usda.gov/climatehubs

Get on the Hub Email list

For more Information on the Midwest Climate Hub

Facebook:
Midwest Climate Hub

Twitter:
@dennistodey

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USDA

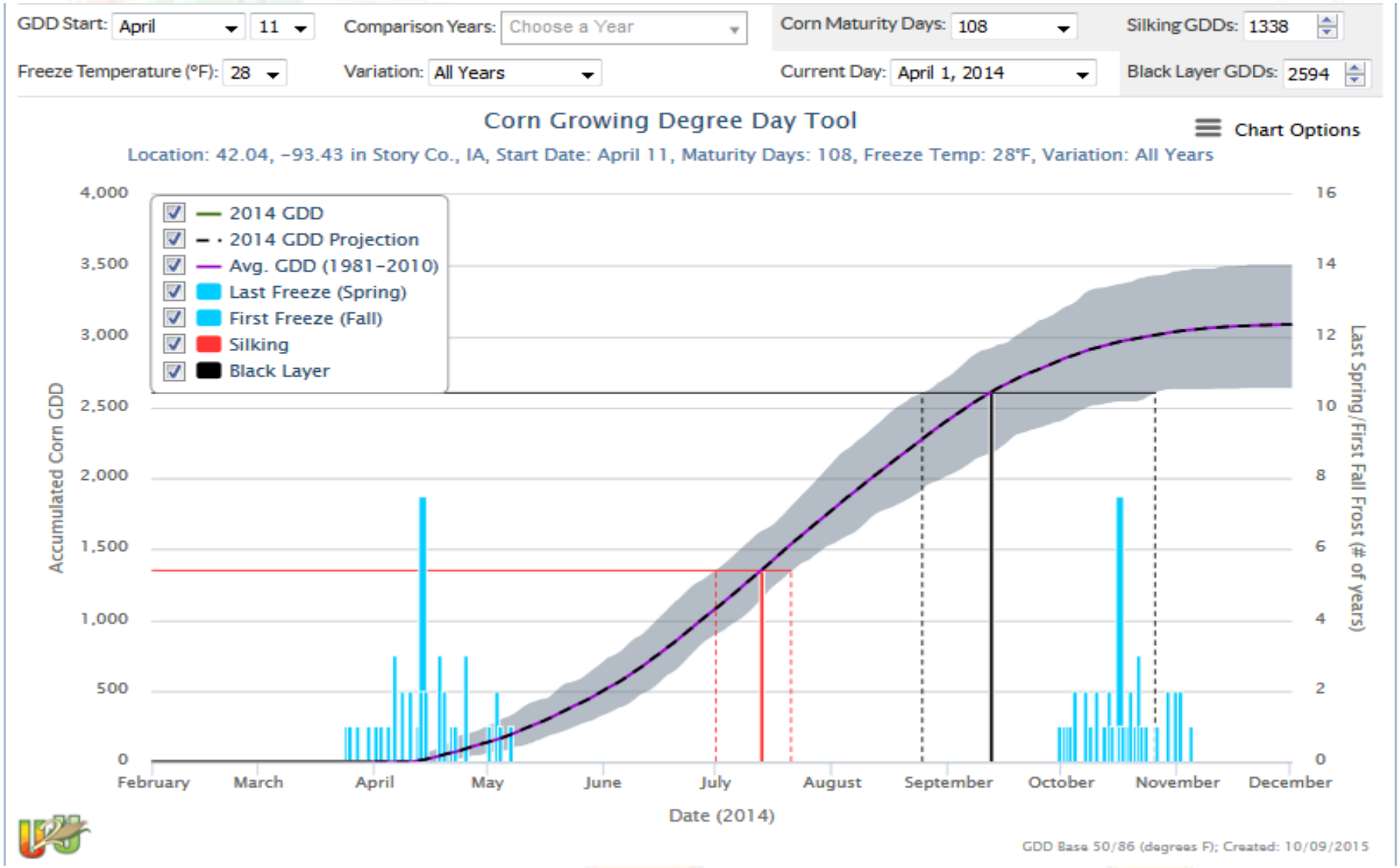
United States Department of Agriculture
Midwest Climate Hub

Corn Growing Degree Days

This tool puts current conditions into a 30-year historical perspective and offers trend projections through the end of the calendar year. Growing Degree Day (GDD) projections, combined with analysis of historical analog data, can help you make decisions about:

- Climate Risks – Identify the likelihood of reaching maturity before frosts/freezes.
- Activity Planning – Consider corn hybrid estimated physiological maturity requirements, along with GDD projections when making seed purchasing and other growing season decisions.
- Marketing – Look at historical and projected GDD when considering forward pricing and crop insurance purchases.

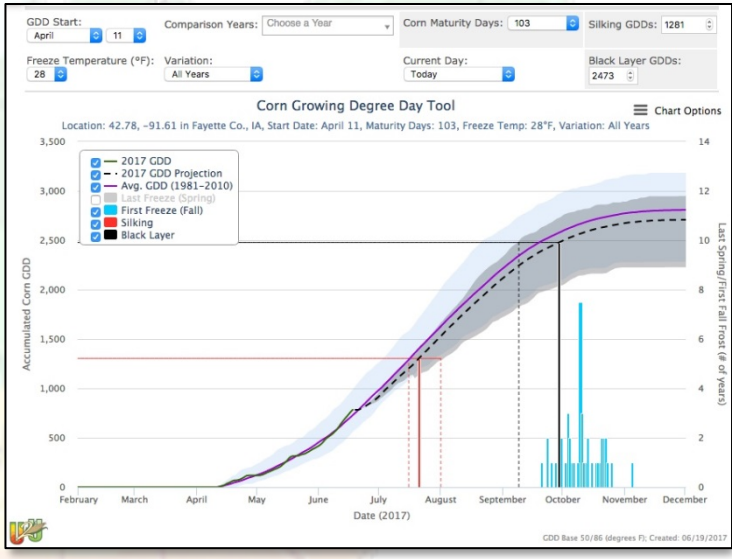
GDD Graph



www.AgClimate4U.org

Collaborative Aspects

- Interpretation, Collection and Translation of Information
  - *Real-Time Decision Support across time and space scales*
  - *Tools*
  - *Research*
  - *Monitoring & Data*
  - *Supporting and Sustaining Planning & Resilience (across time and place)*
  - *Coordination across fed-state-university-extension*

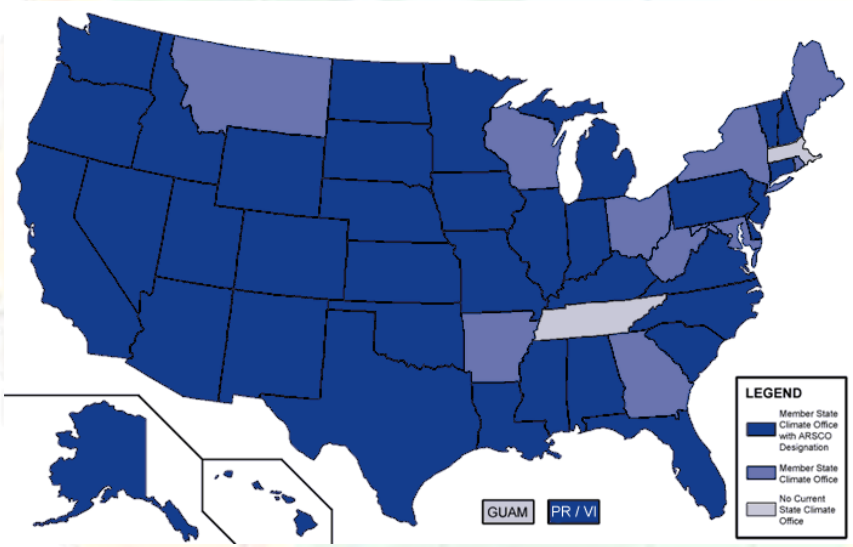


- All to make (NOAA) climate information useable by agriculture (USDA)

Other partners

- State Climatologists
- Regional Climate Centers
- National Drought Mitigation Center

State Climatologists

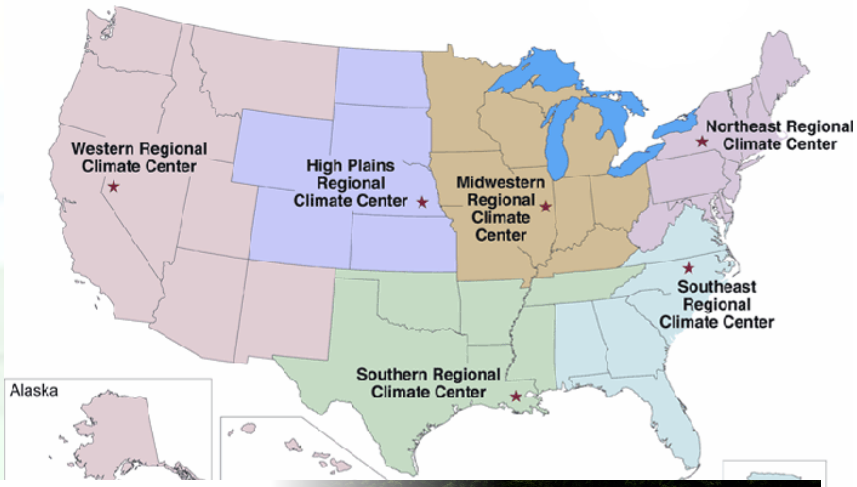


- State climate expertise
- Locals trust locals
- Varies by state needs
- Mostly university – some state agency
  - Networks
  - Outlooks
  - Climate impacts

AASC
AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

Regional Climate Centers

- NOAA and other funding sources
- Regional climate tools, data and other services
- Work with state climatologists and other partners



Why work together on regional climate services?

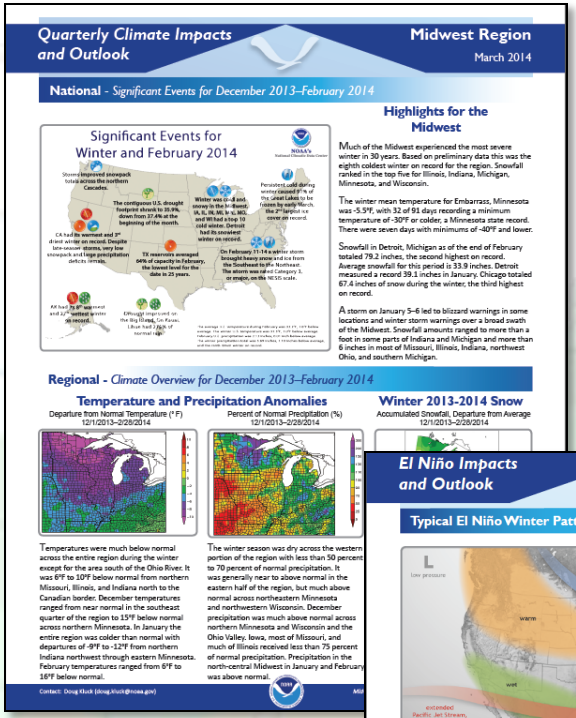
- Capitalize on expertise (Ag. vs Climate)
- Major economic sector in region
- Parallel priorities and goals
- Similar end users and interests
- Bound by impacts (dry, wet, hot, cold extremes)

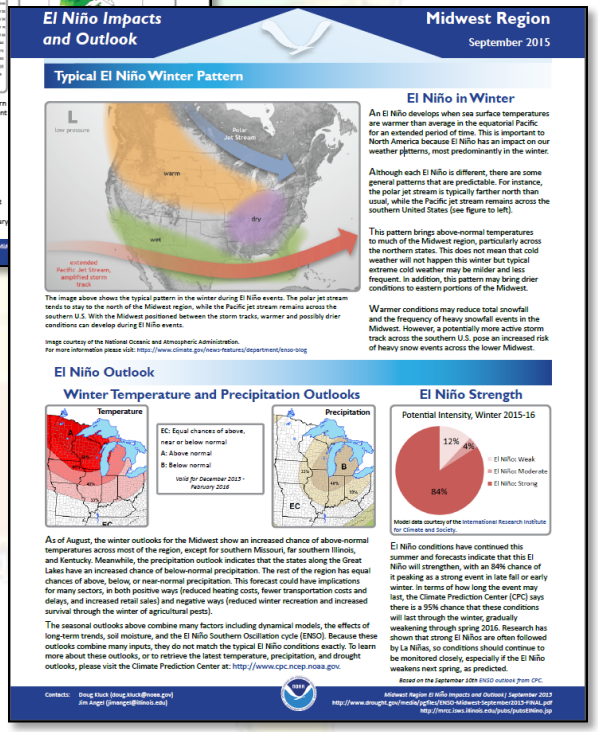
Why USDA?

- NOAA - various regional/local wx/climate capabilities
- USDA – nothing specific to serve agriculture from the fed side
- Special data and outlook needs
  - *Breadth of crops (corn, wheat, rangeland, pumpkins, livestock etc.)*

Climate Support: Routine Briefs

- Quarterly regional briefs
  - *Single page*
  - *Past, Present, Future*
  - *Non-technical*
- ENSO State
  - *Non-technical*
  - *As needed*
  - *Potential regional impacts*
  - *High interest*
- Multi-Partner





Extreme Events:
A need for climate services

- Regional briefs:
  - *Critical impacts, potential extremes*
  - *NOAA climate/weather information*
  - *USDA climate/weather impacts to agriculture*

Alaskan tree frog freezes solid in winter. Source: DL Wilson

- Extremes due to antecedent extremes

- Other critical times:
  - Fall harvest, fall/summer early freezes, spring late freezes
  - pollination/seed filling
  - spring livestock
  - spring fire
  - growing season drought, spring planting

NOAA Inputs: Late Season Cold, Wet, Snow (preceded by warmth)

Major Cold and Wet Spring Event:
Potential Impacts in the North Central U.S.
April 26-May 9, 2017

Prepared By:
Barb Mayes Boustead, Ph.D.
Meteorologist and Climatologist, National Weather Service

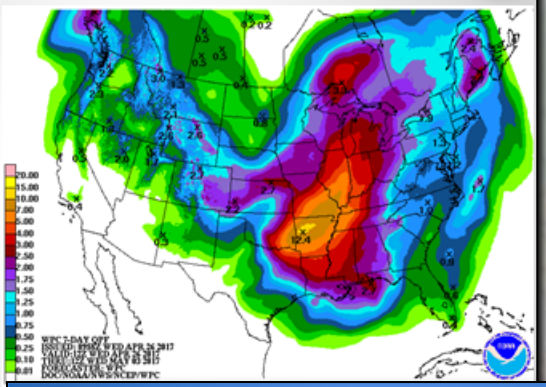
Dr. Dennis Todey
Director – USDA Midwest Climate Hub

In Partnership With:
Doug Kluck (NOAA/National Centers for Environmental Information), Dannele Peck (USDA Northern Plains Climate Hub), Crystal Stiles (High Plains Regional Climate Center), Mike Timlin (Midwestern Regional Climate Center), Ray Wolf (National Weather Service)

Building a Climate-Smart Nation

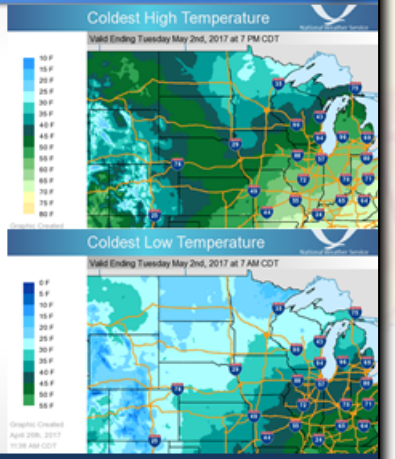
Precipitation: April 26-May 2

- Image: Total forecasted precipitation for the whole week (actual precipitation often is more spotty or varied in coverage)
- **Unusually wet** conditions likely for much of the central U.S. for April 26-May 3
- Combined with cool temperatures



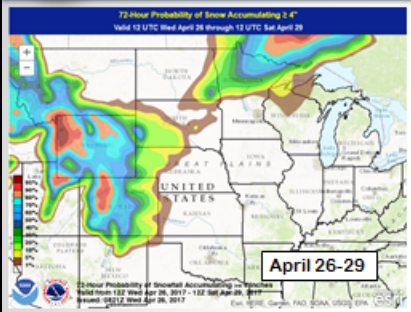
Temperatures: April 26-May 1

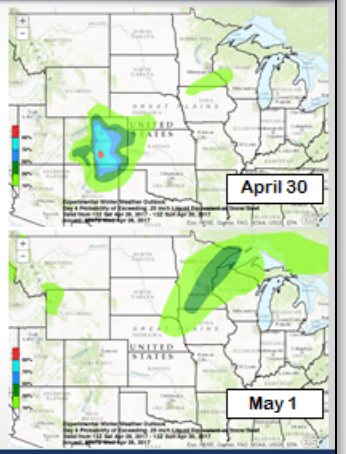
- *Top right*: Coldest high temperatures on any day between April 27 and May 2
- *Bottom right*: Coldest low temperatures on any day between April 27 and May 2
- **Freezing temperatures** possible from the central and northern Plains to the Great Lakes
- **Much below-normal high temperatures** possible across the area
- Conditions may occur on **several days** through the period
- For local weather updates now through 7 days: http://www.weather.gov/



Building a Climate-Smart Nation

Snowfall: April 26-May 2





- *Top left*: Chance of snow >4" total for April 26-29
- *Top right*: Chance of snow >0.25" liquid equivalent for April 30
- *Bottom right*: Chance of snow >0.25" liquid equivalent for May 1
- **Significant snowfall possible** in Wyoming, Colorado

Building a Climate-Smart Nation

https://www.drought.gov/drought/dews/midwest/reports-assessments-and-outlooks

Midwest and Great Plains Climate-Drought Outlook 15 September 2016

Dr. Dennis Todey
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515-294-2013

National Drought Mitigation Center

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

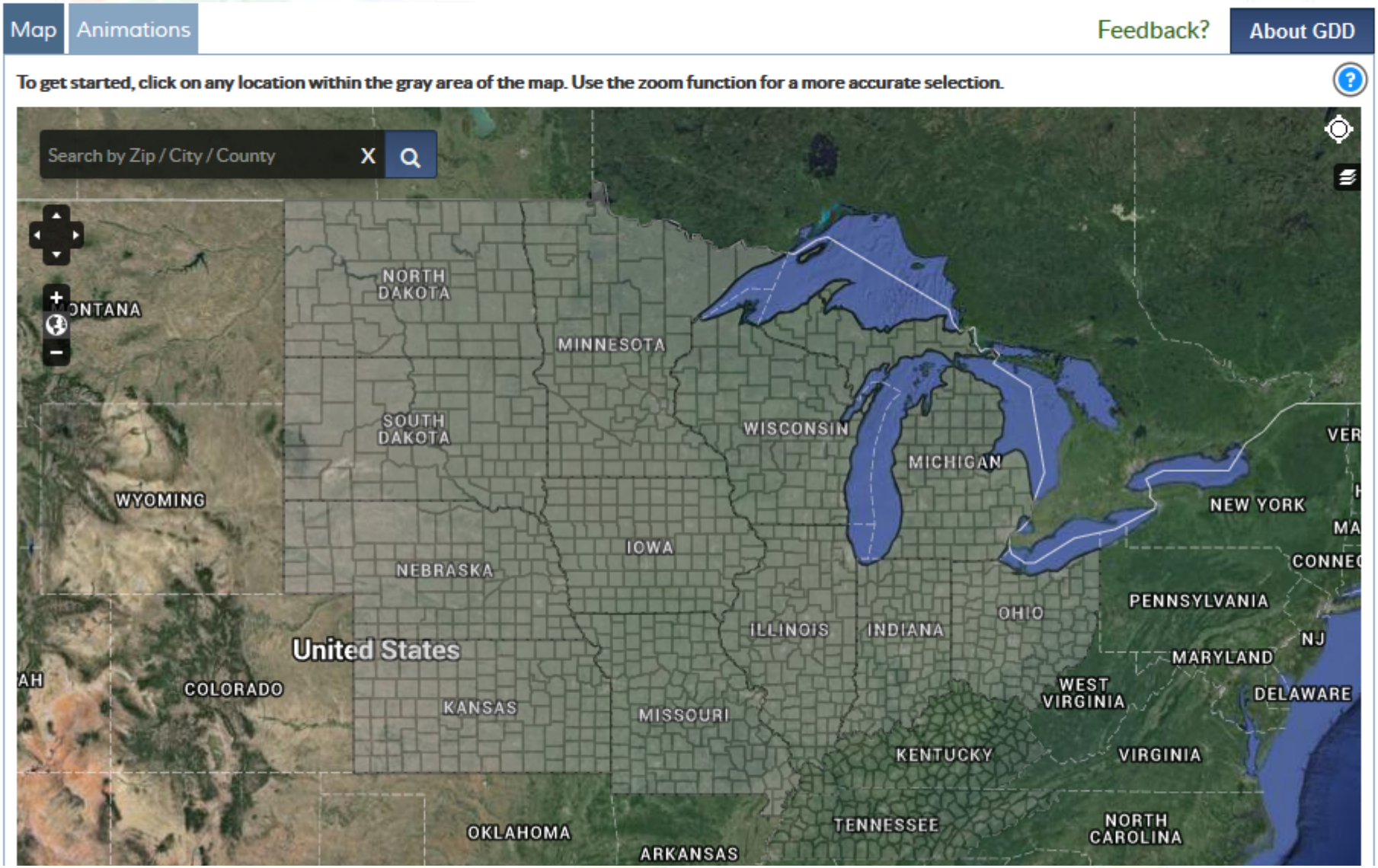
Regional Climate Centers

AASC American Association of State Climatologists

USDA United States Department of Agriculture Midwest Climate Hub

Pick Your Location

useful to usable



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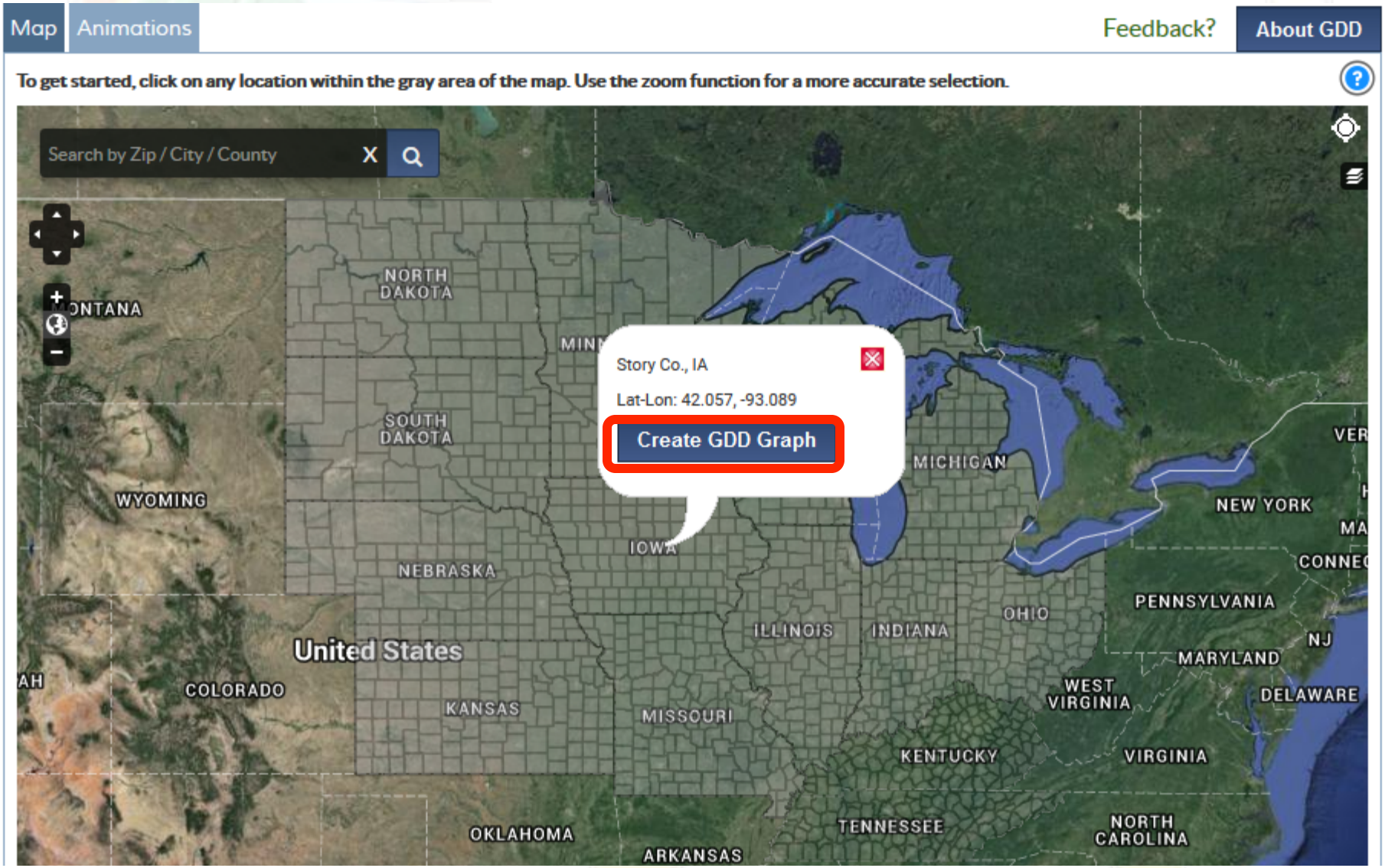
For Example:

useful to usable



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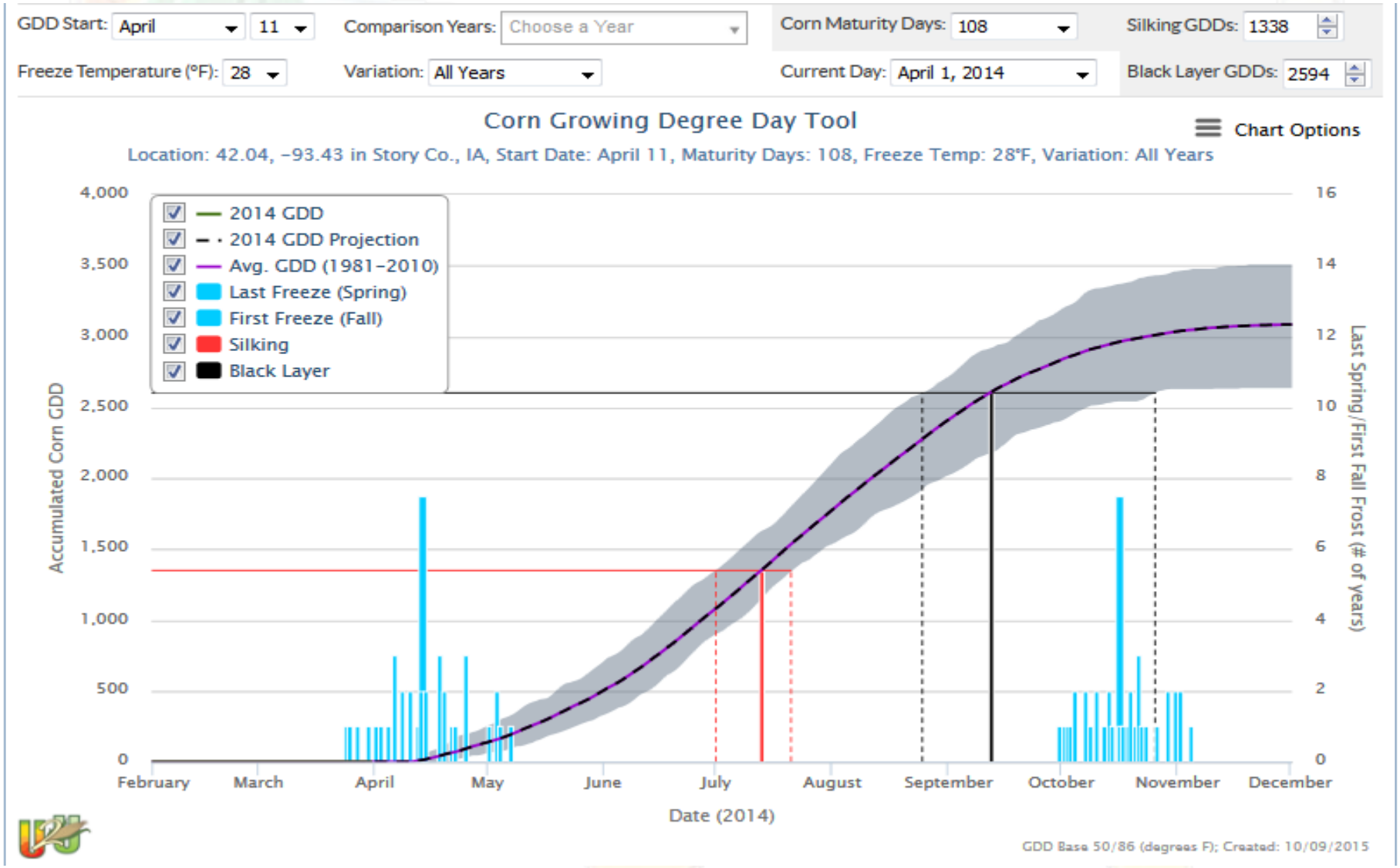
GDD Graph



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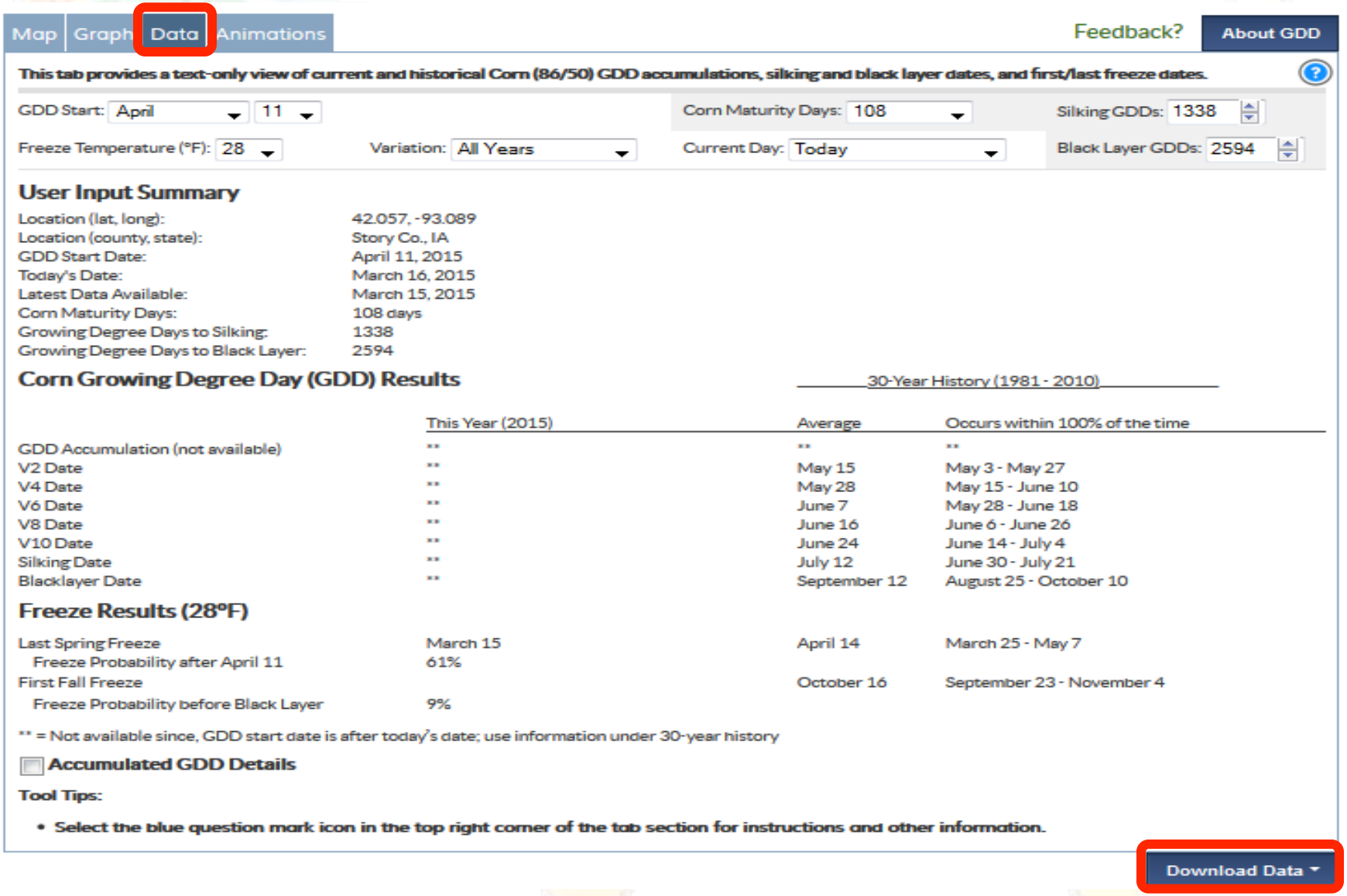
Data Details and Download



Map | Graph | Data | Animations

Feedback? About GDD

This tab provides a text-only view of current and historical Corn (86/50) GDD accumulations, silking and black layer dates, and first/last freeze dates.

GDD Start: April 11 | Corn Maturity Days: 108 | Silking GDDs: 1338

Freeze Temperature (°F): 28 | Variation: All Years | Current Day: Today | Black Layer GDDs: 2594

User Input Summary

Location (lat, long):	42.057, -93.089
Location (county, state):	Story Co., IA
GDD Start Date:	April 11, 2015
Today's Date:	March 16, 2015
Latest Data Available:	March 15, 2015
Corn Maturity Days:	108 days
Growing Degree Days to Silking:	1338
Growing Degree Days to Black Layer:	2594

Corn Growing Degree Day (GDD) Results

	This Year (2015)	30-Year History (1981 - 2010) Average	Occurs within 100% of the time
GDD Accumulation (not available)	**	**	**
V2 Date	**	May 15	May 3 - May 27
V4 Date	**	May 28	May 15 - June 10
V6 Date	**	June 7	May 28 - June 18
V8 Date	**	June 16	June 6 - June 26
V10 Date	**	June 24	June 14 - July 4
Silking Date	**	July 12	June 30 - July 21
Blacklayer Date	**	September 12	August 25 - October 10

Freeze Results (28°F)

Last Spring Freeze	March 15	April 14	March 25 - May 7
Freeze Probability after April 11	61%		
First Fall Freeze		October 16	September 23 - November 4
Freeze Probability before Black Layer	9%		

** = Not available since, GDD start date is after today's date; use information under 30-year history

Accumulated GDD Details

Tool Tips:

- Select the blue question mark icon in the top right corner of the tab section for instructions and other information.

Download Data

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AgClimate View

- Plot local temperature and precipitation variation as far back as 1980,
- Track county crop yields and trends, and
- Consider crop yields in the context of temperature, precipitation, and growing degree day data

Used in tandem with other decision resources, AgClimate View can help you find long-term correlations between climate trends and yields, while helping you put your recent crop experience into historical context.

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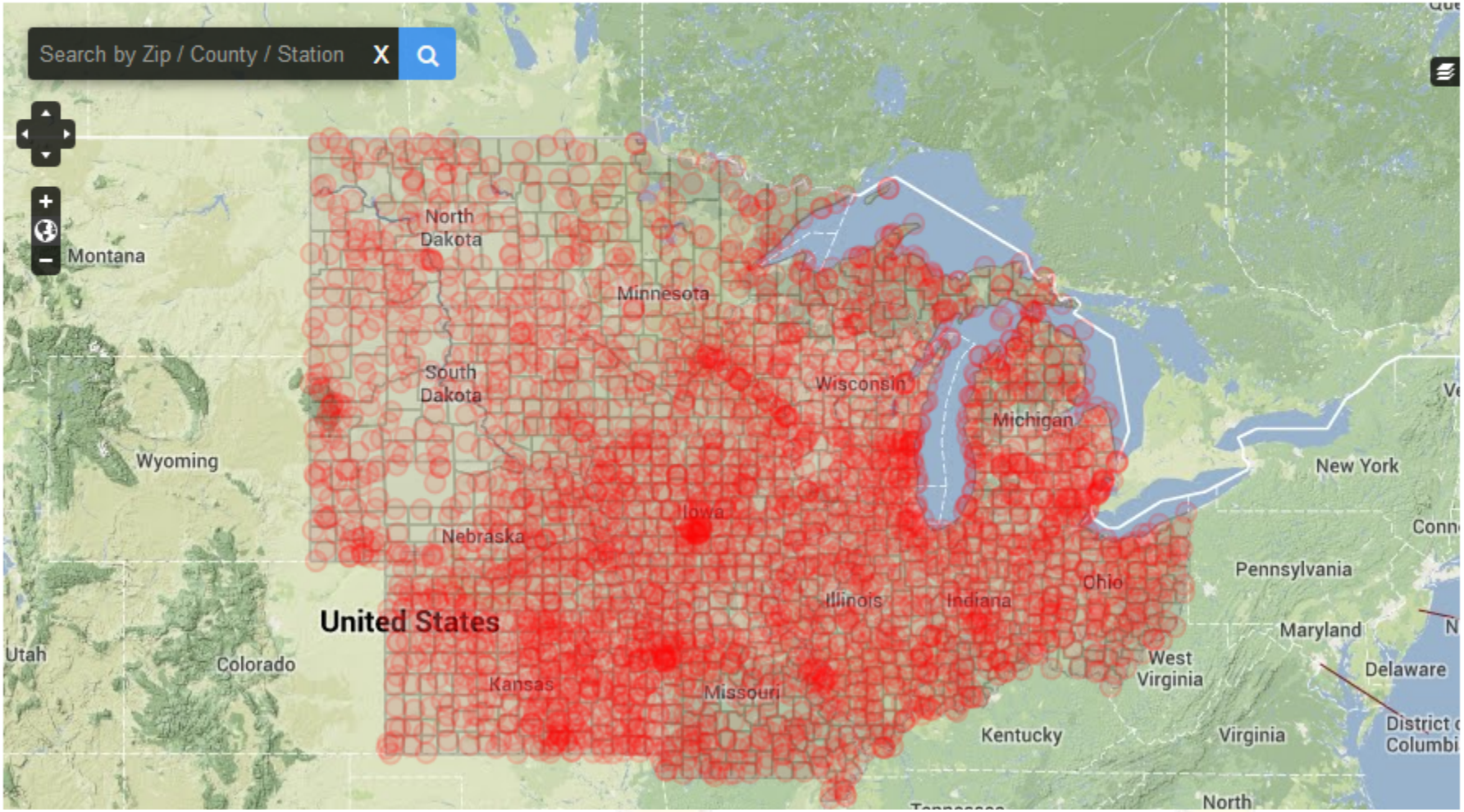
Start by Selecting a Location

useful to usable

Select a Station

To get started, select a station near you. Do this by clicking on the map or using the search feature.



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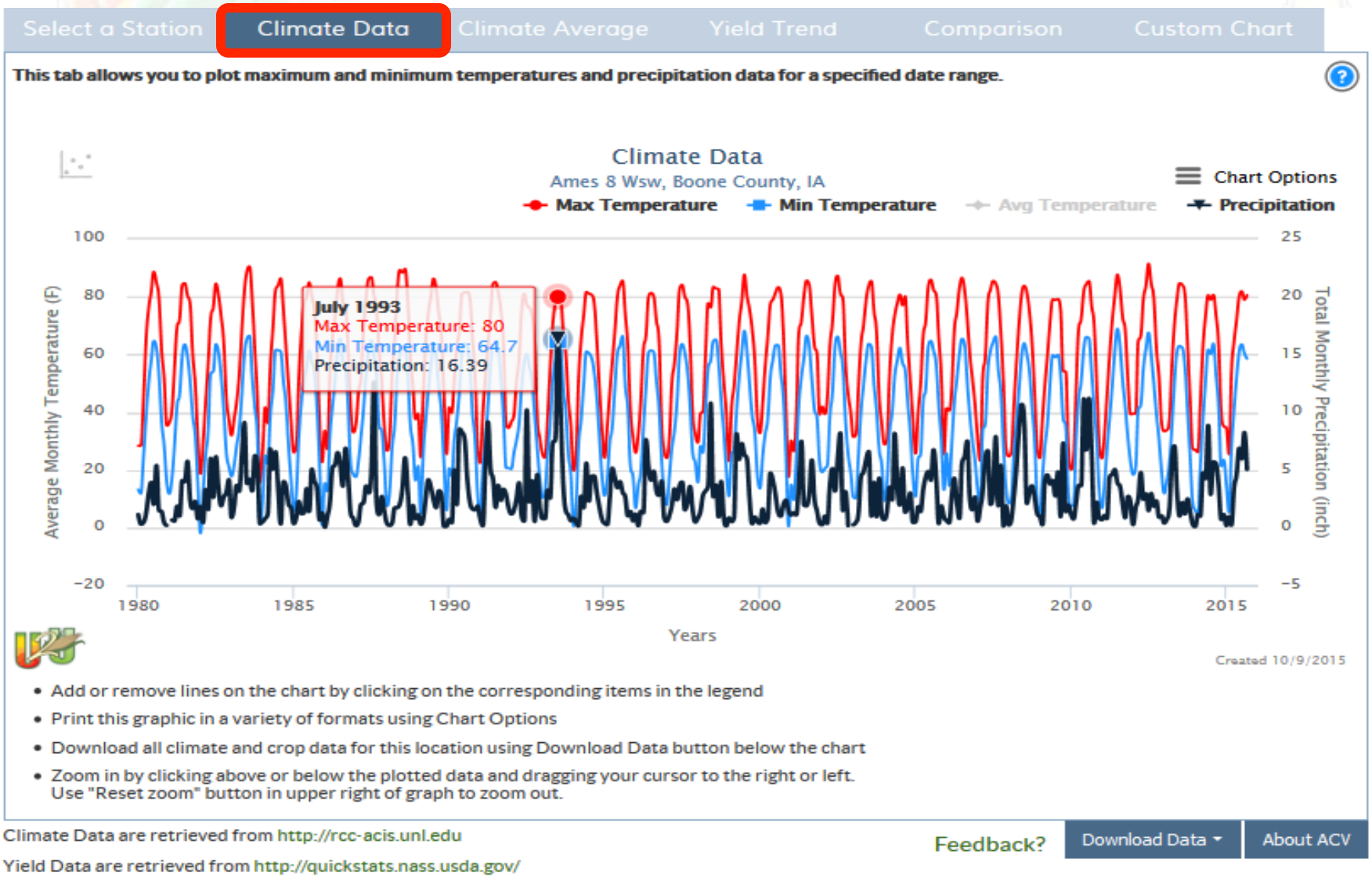
Historical Weather Data



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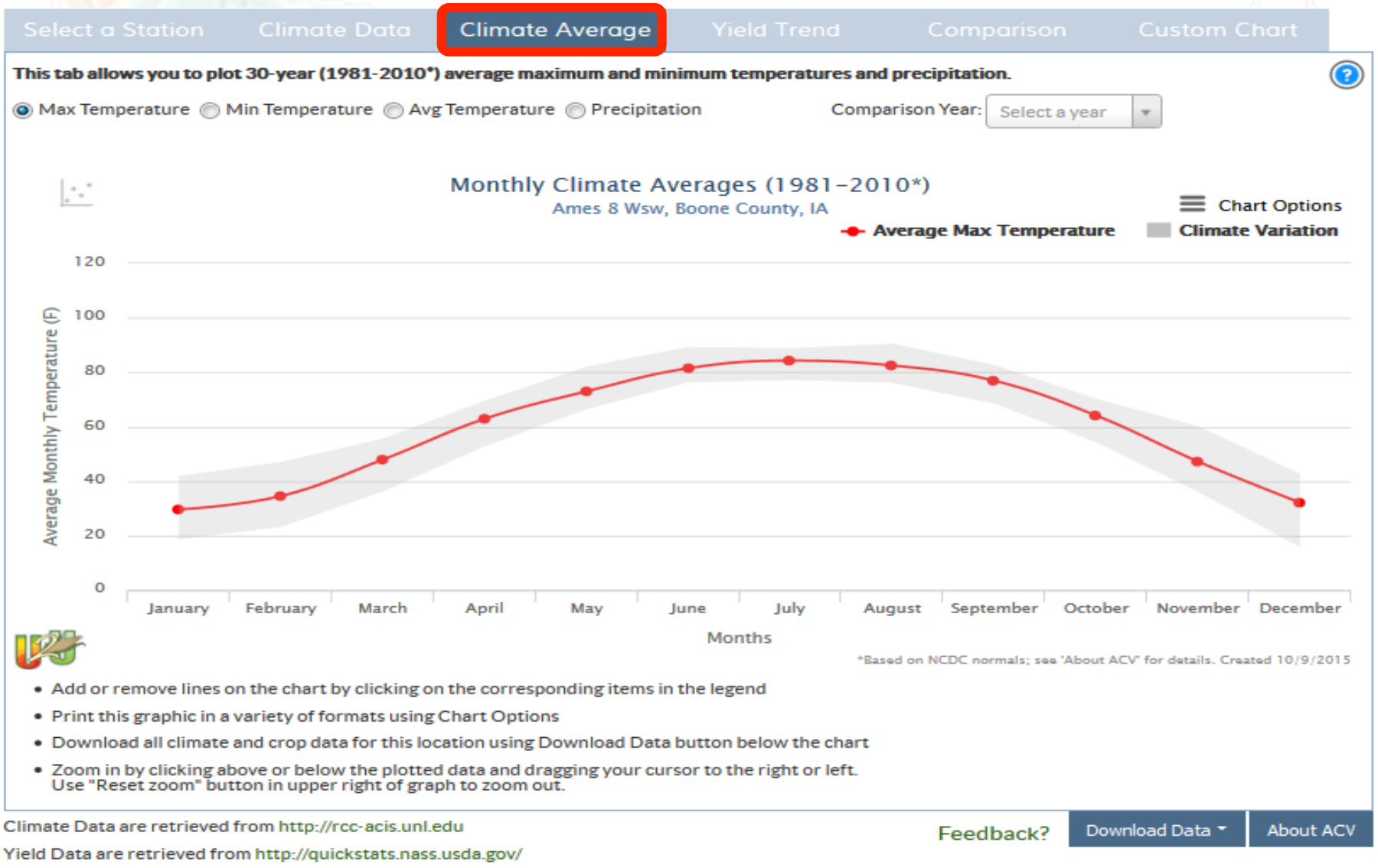
Climate Averages



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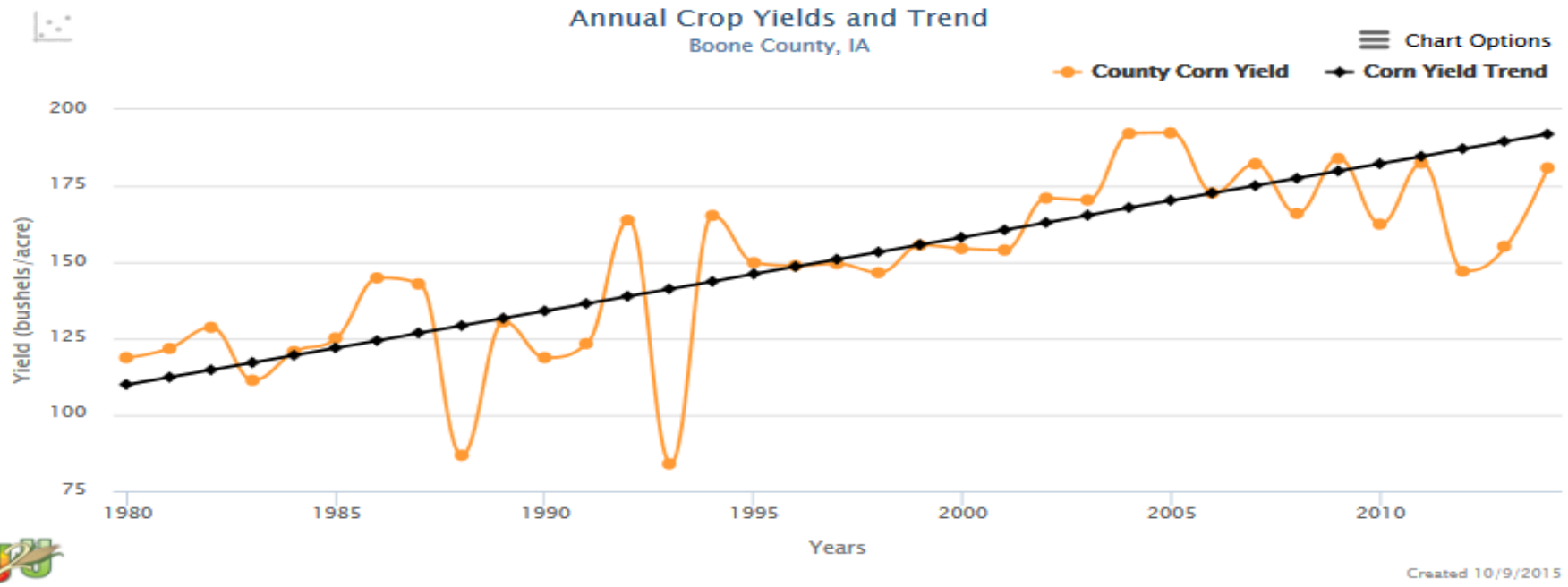
Crop Yields and Trends

useful to usable

Select a Station | Climate Data | Climate Average | **Yield Trend** | Comparison | Custom Chart

This tab allows you to view annual county yields for a selected time period and the corresponding linear yield trend.

Corn Trend Soybean Trend



- Add or remove lines on the chart by clicking on the corresponding items in the legend
- Print this graphic in a variety of formats using Chart Options
- Download all climate and crop data for this location using Download Data button below the chart
- Zoom in by clicking above or below the plotted data and dragging your cursor to the right or left. Use "Reset zoom" button in upper right of graph to zoom out.

Climate Data are retrieved from http://rcc-acis.unl.edu

Yield Data are retrieved from http://quickstats.nass.usda.gov/

Feedback? | Download Data | About ACV

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Combine the Data

Select a Station | Climate Data | Climate Average | Yield Trend | **Comparison** | Custom Chart

This tab allows you to plot countywide annual yield data with up to two climate variables.

Step 1: Select one of the crops

(•) Corn ( ) Soybean ( ) None

Step 2: Select up to two monthly climate variables

Show Weather Values

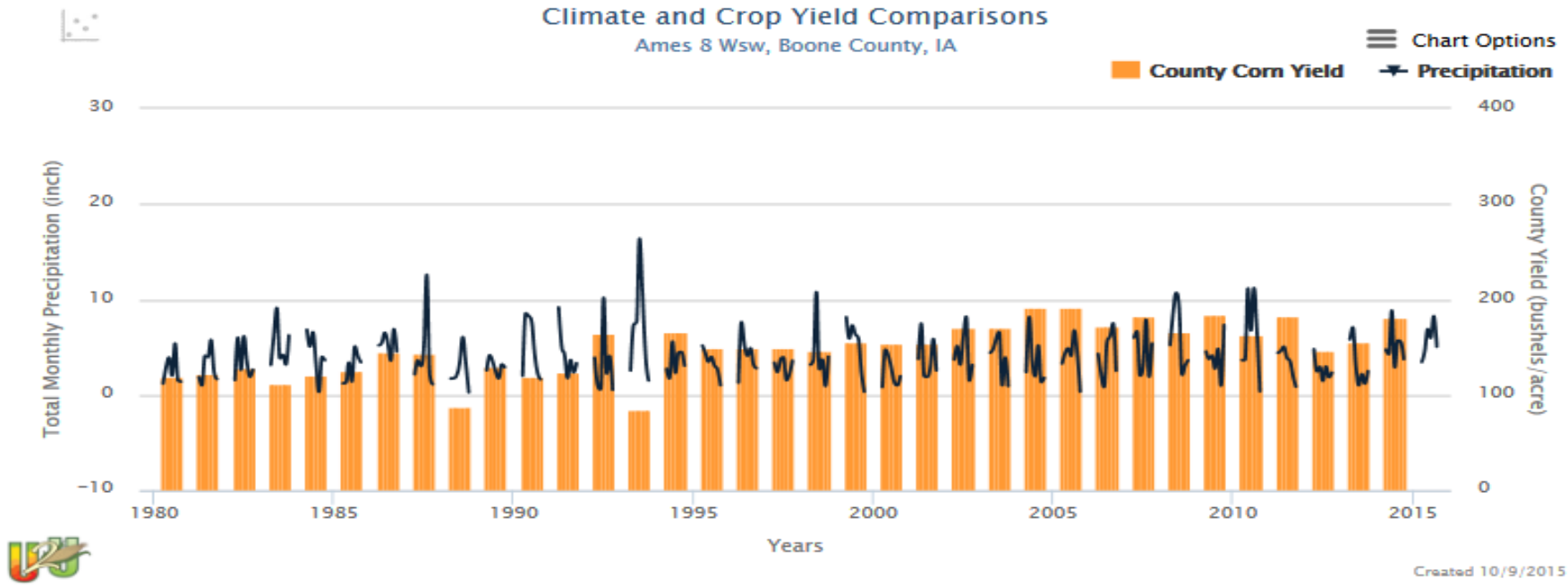
[ ] Max Temperature [ ] Min Temperature [x] Precipitation [ ] GDD50 [ ] SDD90

Step 3: Select start & end month range to plot

April — October

Step 4: Select start & end year range to plot

1980 — 2015



- Add or remove lines on the chart by clicking on the corresponding items in the legend
- Print this graphic in a variety of formats using Chart Options

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Climate Patterns Viewer

This tool provides a historical (1981-2010) look at how the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) have affected local climate conditions across the Corn Belt. You can explore the influence on:

- average monthly total precipitation,
- average monthly temperature,
- deviations of these variables from 1981-2000 normals, and
- deviations of these variables from neutral phases.

The maps can help you make decisions about:

- Climate Risks – Identify periods of more extreme weather.
- Activity Planning – Consider crop choice and irrigation needs.
- Marketing – Explore forward pricing alternatives.

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Mapping the Relationships

U2U Decision Support Tools - Climate Patterns Viewer

Welcome to Climate Patterns Viewer – connecting global climate conditions to local climate impacts.

This product provides a historical look at how the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) can influence local climate conditions and corn yield across the Corn Belt. You can use these simple maps and charts to show when and where specific phases of ENSO or AO have influenced:

- average monthly temperatures and precipitation,
- deviations of temperature and precipitation from 1981-2010 climate normals, and
- average detrended corn yields (adjusted to 2010 technology) and deviations from average

CURRENT CLIMATE PHASE
ENSO: El Niño
AO: Negative (July)

ENSO ALERT STATUS
El Niño Advisory

This tool is not intended to be a forecast. Rather, this tool uses historical data (1981-2010) to highlight locations where ENSO and AO can potentially impact climate conditions over the course of the year, which can help you make more informed farm management decisions.

Feedback? About CPV

Click on the map to view a chart of the data for that location; chart will appear below the maps. Four Maps

ENSO Average Observed Monthly Precipitation (inches)

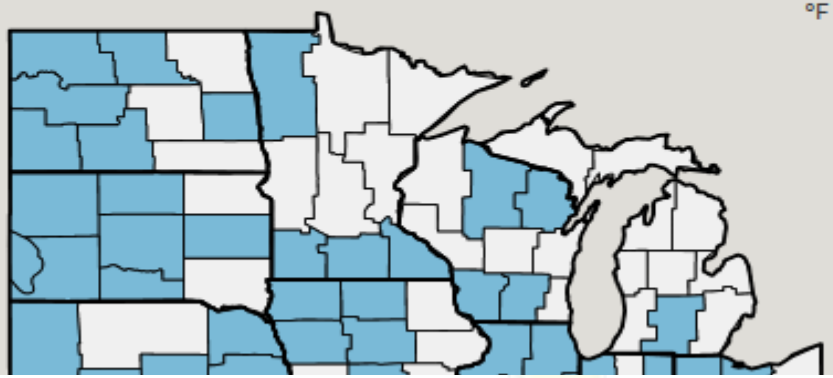
El Niño | Deviation from Normal | October

-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 inches

ENSO Average Observed Monthly Mean Temperature (°F)

El Niño | Deviation from Normal | October

-3 -2 -1 0 1 2 3 4 5 6 °F



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Types of Impacts

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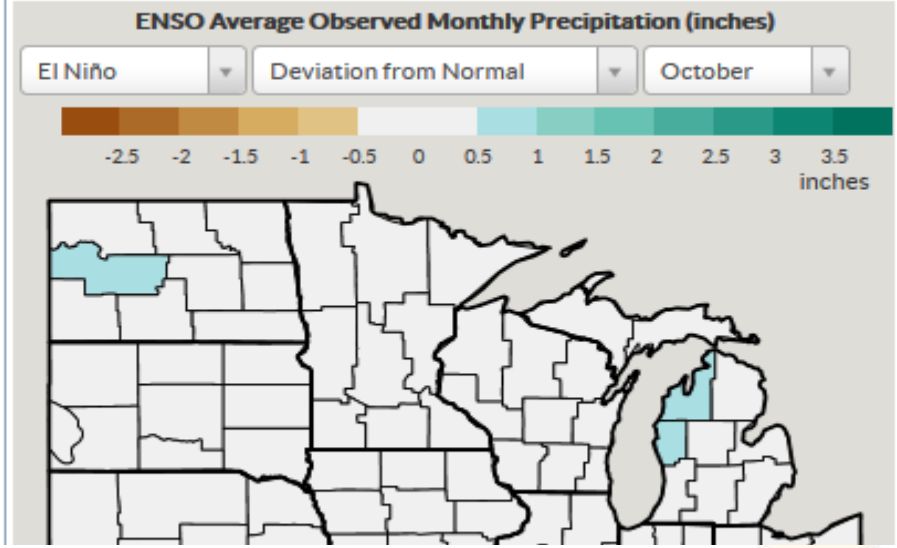

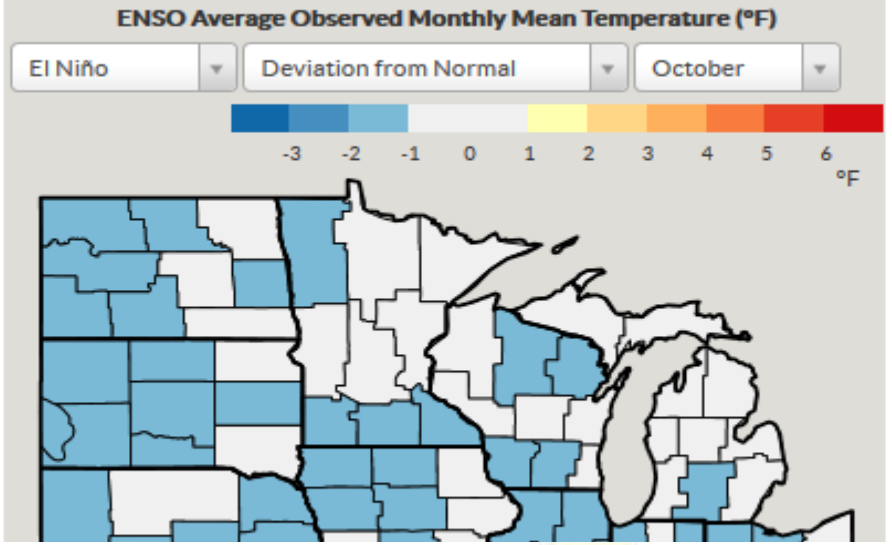

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Current Conditions

U2U Decision Support Tools - Climate Patterns Viewer

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- deviations of temperature and precipitation from 1981-2010 climate normals, and
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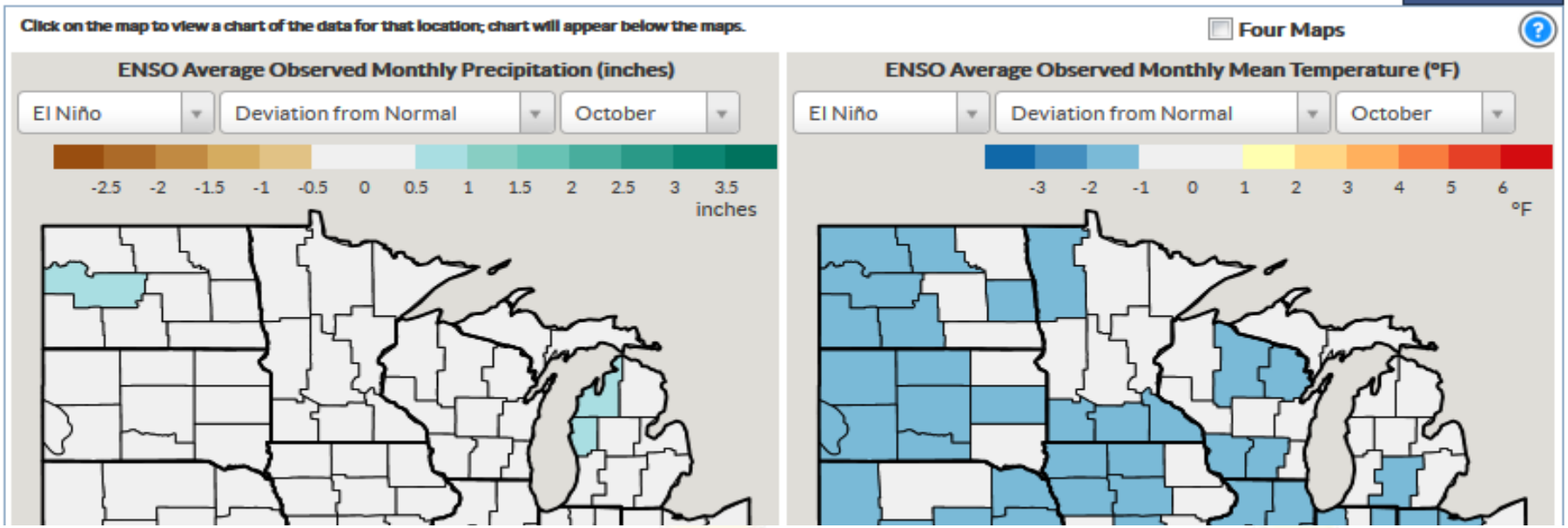

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